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Characterizing fractures across the Astronaut Corps: Preliminary findings from population-level analysis

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Despite evidence of bone loss during spaceflight and operational countermeasures to mitigate this loss, the subsequent risk of fracture among astronauts is not known. The physiologic process of diminished bone density and bone recovery during or following spaceflight is multifactorial. Such factors as age, sex, fracture history, and others may combine to increase fracture risk among astronauts.

As part of the 2016 Bone Research and Clinical Advisory Panel (RCAP), the authors analyzed data collected on 338 NASA astronauts to describe the demographics, bone-relevant characteristics, and fracture history of the astronaut population.

The majority of the population are male (n=286, 84.6%), have flown at least one mission (n=306, 90.5%), and were between the ages of 30 and 49 at first mission (n=296, 96.7% of those with at least one mission). Of the 338 astronauts, 241 (71.3%) experienced a fracture over the course of their lifetime. One hundred and five (43.5%) of these 241 astronauts only experienced a fracture prior to being selected into the Astronaut Corps, whereas 53 (22.0%) only experienced a fracture after selection as an astronaut. An additional 80 astronauts (33.2%) had both pre- and post-selection fractures. The remaining 3 astronauts had a fracture of unknown date, which could not be categorized as pre- or post-selection.

Among the 133 astronauts with at least one post-selection fracture, males comprised 90.2% (n=120) compared to 84.5% of the entire Corps, and females accounted for 9.8% (n=13) compared to 15.4% of the Corps. Ninety-seven of the 133 astronauts with post-selection fractures (72.9%) had one fracture event, 22 (16.5%) had two fractures, and 14 (10.5%) had three or more fractures. Some astronauts with multiple fractures suffered these in a single event, such as an automobile accident. The 133 astronauts with a post-selection fracture accounted for a total of 188 fracture events. One hundred and four (78.2%) of astronauts with post-selection fractures experienced those fractures following their first mission (mean 12.7 ± 11.1 years following first mission; range 14.0 days - 50.6 years).

Additional analyses are ongoing and include examination of fracture history, skeletal site, mechanism, and type of fracture, age at time of fracture, time from spaceflight to fracture, as well as multivariable analysis comparing fracture events to non-events. The results of such analyses may reveal trends in risk factors for fracture among the astronaut corps that have yet to be systematically described through a corps-wide approach.